

REMARKS

Claims 1-28 are presently pending in this application. Claim 15 has been amended. No new matter has been added by the amendment.

The application is directed to an optical system and method for processing a medical image of bodily tissue. The motivation of the invention is the recognition that early detection of cancer is extremely important for the successful treatment of cancer. In one embodiment, the systems and methods of the present invention use the original medical images such as, for example, mammograms and Pap smears, in which the abnormal changes, e.g., microcalcifications, are buried in surrounding tissue. The invention provides for apparatus and methods that use spatial frequency filtering to enhance the desired components while filtering out the undesired components present in the medical images, so that a radiologist or a pathologist can more easily diagnose and prescribe appropriate treatment (See for example, ¶3 of published application).

In one embodiment, a light source emits a light beam directed at the input medical image. A lens Fourier transforms the light passing through the image at the Fourier plane. In that Fourier plane, a spatial filter removes certain undesirable frequency components and allows the transmission of the remaining desirable components. A second lens inverse Fourier transforms the resulting filtered spectrum to form the processed image.

Claim Rejections – 35 USC § 103

Independent claims 1 and 15 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Rao et al. (US 5854710), hereafter Rao-710, in view of Alfano et al. (US 5710429). Independent claim 26 has been rejected under 35 U.S.C. 103(a) as being unpatentable over Rao-710 in view of Alfano and in further view of Burke et al (US 6421454).

Rao-710 is directed to systems and methods for optical Fourier processing of input images **based on photoinduced anisotropy of photochromic materials** (Abstract). In Rao-710 the Fourier transform of a polarized beam from the optical image illuminates a photochromic material film along with a polarized actinic beam. The actinic beam causes a rotation of the angle of

polarization of the image beam by different angles at different locations on the film corresponding to different spatial frequencies (Col. 10, Lines. 25-64, Fig. 1). The resulting beam is then inverse Fourier transformed and passed through an analyzer, which performs low-, band-, and high-pass filtering, and notch filtering (Id.; Col. 12, Lines. 38-44).

Alfano is directed to imaging an **object in or behind a highly scattering medium**. Alfano's technique separates different temporal components of the light scattered from turbid media. A light source illuminates the highly scattering medium. The light that emerges from the medium itself consists of ballistic, snake-like, and diffusive components. The emerged/transmitted light is Fourier transformed. The ballistic component and most of the snake-like component of the light are transformed onto the center optical axis, while the diffusive component is transformed more or less uniformly around the central optical axis on the Fourier plane. A spatial filter, an aperture, centered at the Fourier plane filters out most of the diffusive component and allows the ballistic and snake components to pass through. The resulting light is collected by another lens and detected by a photo detector (Col. 3, Lines. 47-Col. 4, Line. 1).

Applicants submit that Rao-710 does not teach or suggest every element of the independent claim 1. For example, contrary to what was stated in the office action, Rao-710 does not disclose "a spatial filter in the Fourier plane that filters the transformed light by removing a first frequency component and transmitting a second frequency component." The film in Rao-710's Fourier plane does not filter Fourier components of the image beam, rather it rotates the polarization angle for some Fourier components.

Moreover, Alfano does not supply that which is missing from Rao-710. As described above, Alfano is related to the imaging of an object, while both Rao-710 and the present application are related to systems for image processing of a previously captured image to enhance the detection of abnormalities that are medically significant. In Alfano, the input light emerges from a scattering medium which includes an object, and Alfano intends to form an image of that object as an output (Abstract, Col. 1, Lines. 7-9). On the contrary, in Rao-710 a medical image is used as an input and Rao-710 intends to process that image. Similarly, the present invention is related to processing input

images, more specifically, processing of medical images of bodily tissue. Thus Alfano's invention is directed to a scope that is different from that of Rao-710 or the present invention, and it would not have been obvious to one of ordinary skill in the art to combine Rao-710 with Alfano in a manner that results the presently claimed invention.

In addition, the combination of Rao-710 and Alfano does not render the present claimed invention unpatentable. If Rao-710 is combined with Alfano, Rao-710's system must be installed at the tail end of Alfano's system, i.e., to receive as an input that which forms the output of Alfano's system. Alfano's system forms an image of an object (e.g., the image at location 25 in Fig. 1), and Rao-710's system analyzes and performs different types of filtering of that image. This combination does not supply the features that are missing from Rao-710, specifically the spatial filter that is missing from the Fourier plane of Rao-710.

Further, the pending claims of the present application are not rendered obvious by the cited references, since they respond to a long standing demand in the design community which has not been addressed by the cited references. Rao-710 utilizes an arrangement which requires two beams, a polarizer, an analyzer, and a photochromic material (bR) film (Fig. 1). On the other hand, the present claimed invention, by utilizing a mechanism different from that of Rao-710, replaces the above elements simply with one beam and a spatial filter and use low cost optical spatial filtering systems. Alfano uses spatial filtering for an entirely different application – separating of diffused and ballistic photons after propagating through a scattering medium. As a result, the present application provides a “cost effective optical system for image processing ... [which] includes a low cost, durable, portable battery operated system for rapid screening of mammograms and Pap smears” (see for example, ¶6). Such a solution has not been addressed in the ten years since Rao-710 was patented. Instead, during this period, other solutions have been pursued which use digital image processing schemes that rely on computers and which are more expensive and less feasible for small budget medical centers (see ¶4). In contrast, the present invention provides a low cost solution, for example for radiologists or other medical experts, to process mammograms in real-time and to detect breast cancer in an early stage (see for example ¶39).

Independent claims 15 and 26 recite limitations similar to the above elements of independent claim 1, and are similarly rejected based on Rao-710 and Alfano. All other claims depend from one of these independent claims. Thus, Applicants contend that, at least for the above reasons, all rejected claims are patentable.

Dependent claims 11, 12 and 25 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Rao-710 in view of Alfano and in further view of Buchan (US 3700902). The rejection relies on Buchan to supply the controller recited in claim 11, the processor, image storage, and display device recited in claim 12, and the controller and electronic representation recited in claim 25. Claims 11 and 12 depend from independent claim 1, and claim 25 depends from independent claim 15. Buchan does not supply to Rao-710 and Alfano the above mentioned features of independent claims 1 and 15 that Rao-710 and Alfano are missing. Thus, regardless of whether or not Buchan supplies the listed extra features recited in claims 11, 12, and 25, and at least for the reasons stated earlier, these claims are patentable over Rao-710, Alfano and Buchan.

Further, dependent claims 3, 17, 4, and 18 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Rao-710 in view of Alfano and in further view of Trezza (US 20020067535). The rejection relies on Trezza to supply the mammogram recited in claims 3 and 17, and the Pap smear recited in claims 4 and 18. Claims 3 and 4 depend from independent claim 1, and claims 17 and 18 depend from independent claim 15. Trezza does not supply to Rao-710 and Alfano the above mentioned features of independent claims 1 and 15 that Rao-710 and Alfano are missing. Thus, regardless of whether or not Trezza supplies the mammogram and Pap smear as recited in claims 3, 17, 4, and 18, and at least for the reasons stated earlier, these claims are patentable over Rao-710, Alfano and Trezza.

Further, dependent claim 14 has been rejected under 35 U.S.C. 103(a) as being unpatentable over Rao-710 in view of Alfano and in further view of Beraudo (US 4625325). The rejection relies on Beraudo to supply an input image that has a size of less than 10 cm^2 , as recited in claim 14. Claim 14 depends from independent claim 1. Beraudo does not supply to Rao-710 and Alfano the above mentioned features of independent claim 1. Thus, regardless of whether or not Beraudo

supplies the listed extra features recited in claim 14, and at least for the reasons stated earlier, claim 14 is patentable over Rao-710, Alfano and Beraudo.

In addition, claims 26-28 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Rao-710 in view of Alfano and in further view of Burke et al (US 6421454). The rejection relies on Burke to supply the mammographic image recited in these claims. Claims 27 and 28 depend from independent claim 26. Burke does not supply to Rao-710 and Alfano the above mentioned features of independent claims 26 that Rao-710 and Alfano are missing. Thus, regardless of whether or not Burke supplies the mammographic image to claims 26-28, and at least for the reasons stated earlier, these claims are patentable over Rao-710, Alfano and Burke.

In view of the above Remarks, Applicants submit that the pending application is in condition for allowance, and such action is respectfully solicited.

Applicants believe no fee is due with this response and the present response is timely filed. However, if a fee is due, please charge our Deposit Account No. 08-0219, under Order No. 1823430.00123US2 from which the undersigned is authorized to draw.

Respectfully submitted,

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